

10 **INTENTION-BASED AUTOMATED CONFLICT PREDICTION AND NOTIFICATION  
SYSTEM**

15 **CROSS REFERENCE TO RELATED APPLICATIONS**

This patent application claims priority to commonly-owned United States Provisional Patent Application Serial No. 60/221,131 entitled “*System and Method for Command, Control, and Communication for Personnel and Weaponry*” filed on July 25, 2000, which is hereby incorporated by reference in its entirety.

20 **TECHNICAL FIELD**

The present invention relates generally to the field of automated systems, and more particularly to an automated system for predicting conflicts among issued instructions based on the issuer's intent, and notifying the appropriate users of the potential conflicts.

25 **BACKGROUND OF THE INVENTION**

Amidst a technologically advanced society, the quest for increasing automation with effective integration continues. From coffee makers with an automatic start to military control centers with automatic notification of enemy vessels, automation often necessitates the inclusion of some problem recognition features. For example, some

coffee makers include an automatic shut off that recognizes leaving the coffee maker on too long can also create a problem. Without problem recognition, automated systems could continue in a regular operation mode, which often exacerbates the problem. Consequently, there has been development in the area problem recognition.

5 Numerous systems include a rule-based problem recognition system designed to issue some sort of notification when a problem is recognized. When systems receive information from several sources, these systems may recognize that a problem exists as received information conflicts with one of the preset rules. Rule based conflict recognition has been used in many areas including military tactics. Militaries employ countless technologies to gather and disseminate battlefield information. Generally, the goal is eliminating uncertainty and conflict recognition using awareness of circumstances, or situational awareness.

10 Situational Awareness refers to an explicit knowledge of the current state of the physical world while Intention Awareness connotes a more implicit knowledge of the mental world. Situational Awareness involves the present moments while Intention Awareness indicates the most probable future states by focusing on the motivations of the actors involved. Intention Awareness informs and enhances Situational Awareness, providing a more comprehensive understanding of an existing situation. Consequently, conflict recognition systems that consider only Situational Awareness are devoid of 15 information that could critically impact the future.

20 To date, Situational Awareness has advanced primarily by providing a soldier with a near real-time view of current battlefield conditions. Some current systems focus on advancing and sharing Situational Awareness by enabling the soldier to receive, compare, and communicate battle state information faster and more accurately. Through 25 the use of embedded computing and communications systems, these Situational Awareness systems enable the coordination of units and weapon systems to participate in a battle with better reliability, lethality, survivability, and tempo of attack.

20 While Situational Awareness does aid in conflict recognition, knowledge of physical circumstances rarely provides a complete view of a situation. Possessing 30 Situation Awareness alone can considerably impact the most common tasks, such as

navigating a busy parking lot. With a brief glance around, a driver becomes immediately aware of the locations of the other cars and people moving around the lot. Knowledge of these objects and their relative positions provide Situational Awareness. Because the situation may change, the driver should be aware of the intentions of the other drivers and pedestrians. For example, a pedestrian can walk behind the driver's car. If the driver remains unaware of the pedestrian's intention, the driver could seriously injure the pedestrian.

Consequently, conflict recognition systems that utilize only Situational Awareness can remain susceptible to potentially dangerous situations. For example, military tactics that use Situational Awareness currently provide a great deal of assistance both in coordinating the flow of orders and information and also in visualizing the current state of battle. However, fratricide studies show that even powerful tools like these still prove insufficient when forced to operate in such a chaotic, interdependent, and fast-paced environment as the 21<sup>st</sup> century battlefield.

Fratricide as used herein means unintentionally firing upon and killing friendly, or non-enemy, troops. Hence, each case of fratricide is a mistake, most often resulting from misidentification, miscommunication, or other factors, which have contributed to a shooter's confusion. However, these mistakes often result in the loss of lives. Some current systems employ Situational Awareness to reduce uncertainty and confusion. Yet, there has been only a minimal reduction in the frequency of fratricide using these systems. As described above, Situational Awareness alone does not provide a complete picture of a given situation.

Accordingly, despite the development in the area of notification systems, conventional solutions still fail to provide a complete view of a given situation. Thus a need still exists for an automated support system that reduces operational uncertainty, notifies users of potential problems, and considers both the physical circumstances as well as the users' intentions when predicting the potential problems.

## SUMMARY OF THE INVENTION

The present invention meets the needs described above by providing an automated conflict prediction and notification system utilizing Intention Awareness that can be used in a host of areas such as management, medical treatment, and military tactics. When used in military tactics, the invention provides predictive error checking, increased Intention Awareness, and enhanced communication.

The invention provides predictive error-checking and conflict resolution by comparing orders and field reports against one another and against existing military databases (for terrain, weather, equipment, artillery, logistics, military doctrine, etc) to determine their validity and tactical effectiveness. Possible conflicts such as advancing units into a line of fire, NBC hazard, airstrike zone, or minefield, or beyond the reach of logistical support, are detected through expert systems analysis and are flagged before they are issued.

In addition to conflict assessment, the invented systems further advance Intention Awareness by enabling commanders to view the orders issued by their subordinates to ensure they conform to their intent. The system further enables commanders to graphically visualize and communicate their intent using multi-level overlays, digital pen capabilities, and so forth, and through the use of graphical spatial-temporal relationship lines between units and areas.

Furthermore, the system provides the use of inexpensive, slightly customized commercial broadband wireless LAN technology to provide a far more powerful and effective Tactical Internet that will have orders of magnitude more throughputs, a far greater range, no line of sight limitations, no infrastructure requirements, and no centralized NOC vulnerabilities. Furthermore, this wireless network architecture will be completely undetectable and unassailable by enemy forces.

Generally described, the present invention includes an automated system for notifying a first user who issued a first instruction and a second user who issued a second instruction of a potential conflict. For example, the instructions can be orders issued by military personnel. The system includes input devices for receiving the first instruction entered by the first user; a passive input device for receiving the second

instruction entered by the second user; an intention determination system for analyzing the instructions, determining if execution of the instructions complies with the users' intent, and issuing an alert if execution of the instructions creates the potential conflict; and first and second user interfaces for respectively notifying the first and second user by 5 displaying the alert. The input devices can include cellular phones, radio transmitters, electronic pads, field sensors, and/or satellites.

In one aspect of the invention, the intention determination system includes an input module for receiving and processing the instructions; a language converter for converting the instructions from a natural language format to a position-based format, 10 wherein the conversion generates restructured instructions; a database for storing both the instructions, the restructured instructions, and reference information; and a rule-based analyzer for periodically retrieving and processing at least some of the instructions, restructured instructions, and reference information to determine if execution of the instructions creates the potential conflict.

In another aspect of the invention, the user interface includes a display panel; a 15 preferences panel for selecting display preferences for objects that appear in the display panel; and a node-based navigation system including four navigational nodes representing preferences, areas of operation, units, and fragmentary orders. In operation, the selection of one of the nodes repositions that node in the center.

In view of the foregoing, it will be appreciated that the automated system of the 20 present invention avoids the drawbacks of prior systems. The specific techniques and structures employed by the invention to improve over the drawbacks of the prior systems and accomplish the advantages described above will become apparent from the following detailed description of the embodiments of the invention and the appended drawings and 25 claims.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**FIG. 1** is a functional block diagram of an intention-based automated conflict prediction and notification system illustrating input/output devices, an intention 30 determination system, and a user interface.

**FIG. 2** is a functional block diagram of the input processor of **FIG.1** illustrating major components within the input processor.

**FIG. 3** is a functional block diagram of the language converter of **FIG. 1** illustrating the processing of a fragmentary order as it goes through the language converter.

5       **FIG. 4** is a functional block diagram of the database of **FIG. 1** illustrating sample tables within the database management system.

**FIG. 5** is a functional block diagram of the analyzer of **FIG. 1** illustrating some of the major components of the analyzer.

10      **FIG. 6A** is a Windows-based screen generated by the user interface of **FIG. 1** illustrating the condition of the battlefield using a multi-panel format.

**FIG. 6B** illustrates two Windows-based screens generated by the user interface of **FIG. 1** illustrating the condition of the battlefield for a simulated mission at subsequent time intervals.

15      **FIG. 6C** depicts two Windows-based screens generated by the user interface of **FIG. 1** illustrating the node based navigational nature of the user interface for a simulated mission.

**FIG. 7** is a logic flow diagram for a method of automatically notifying a user of potential conflict that may exist among issued instructions.

**FIG. 8** is a logic flow diagram illustrating the analyze data routine of **FIG. 7**.

20      **FIG. 9** is a logic flow diagram illustrating the analyze data conflicts routine of **FIG. 8**.

## **DETAILED DESCRIPTION OF THE EMBODIMENTS**

The present invention may be embodied in an intention-based automated conflict prediction and notification system for nondeterministic identification and resolution of conflicts. In computing, nondeterministic applications generally refers to systems whose emergent property is that they depend upon the contextual interaction between users and data. Because conflict identification and resolution of nondeterministic situations applies to many areas, the invented system is applicable in management, medical treatments, and other fields, as well as military operations.

Warfare itself is a chaotic, indeterminate system with thousands of vehicles, processes, areas, soldiers, missions, and actions operating in concert. Yet these interactions and operations never happen in exactly the same way twice. Each operation uses different numbers and types of deployments, each with completely different sets of objectives and variables, yet the invented conflict notification system not only tracks but coordinate all these activities. To be effective, computer systems should model the real-world systems they attempt to serve as closely as possible. For this reason, the invented client notification system has been designed with inherent flexibility so that it can dynamically model situations of indeterminacy. Consequently, the architecture makes the system sufficiently flexible and uniquely capable to both track and coordinate the operations of such a dynamic and nondeterministic (variable) situation such as military operations. When completed and fully integrated, this system is an effective decision-support and conflict resolution tool that easily integrates with current procedures. The system will be most effective in making rapid decisions in situations where overlooking key pieces of information and interdependencies can result in issuing conflicting and/or hazardous orders.

Turning now to the figures, in which like numerals refer to like elements through the several figures, **FIG. 1** is a functional block diagram of an intention-based automated conflict prediction and notification system **100** according to an exemplary embodiment of the invention. The system **100** includes input/output devices **105**, an intention determination system **110**, a user interface **115**, and a communication media **120**. Using the devices **105**, the conflict notification system **100** can either receive information from or transmit information to one or more remote users. For example, a commander of a division could transmit military orders to the intention determination system **110** using one of the devices **105**. Alternatively, a physician could transfer prescribed treatment or a manager could transfer inventory information using the input devices **105**.

Because of the widespread applicability of the system **100**, the input devices **105** could be any one of several types of devices. The devices **105** could include a sensor **132** such as an optical sensor, infrared sensor, low-level sensor, thermal sensor, magnetic sensor, motion sensor, radar sensor, or a combination thereof, with or without

video and/or audio recording capabilities. In some situations, a large number of the sensors would be deployed, while in other situations only one or just a few sensors would suffice. For example, in a military situation, a large number of different types of these sensors could be air-dropped into a battle zone to acquire relative information regarding

5 the field, such as movement of enemy troops, artillery, armor, and other equipment, physical characteristics of the local terrain, and local weather conditions. Similarly, in a medical application this sensor could detect patient movement and in a management application this sensor could detect employee, vehicle, or product movement. As indicated by the arrows, information can be both transferred to the sensor **132** or received from the sensor **132**. For example, the system **100** could request that the sensitivity of the sensor **132** be increased. This information could then be transferred to the sensor **132**.

Also, the devices **105** could include a printer **134** designed to periodically print relevant information. By using the printer **134**, the system **100** could confirm that a "hard copy" of critical information remains available in the event of a power outage. The input/output devices **105** could also include a satellite **136** that gathers weather or position-related information. Additionally, a computer system **137** could also receive and transfer information to the system **100**. Within the computer **137** a text editor, such as Microsoft® Word®, Corel® WordPerfect®, or the like could function as the input device. Furthermore, the input/output devices **105** could include an electronic pad **138**, such as the IBM® Crosspad® that enables digital capturing and transferring of handwritten information. The electronic pad **138** could also be a modified personal digital assistant, such as a PALM® organizer manufactured by 3COM®. In addition, the input/output devices **105** could include a voice recognition device **138**, such as a cellular phone or a radio transmitter. Depending on the particular circumstances, all of these input/output devices can be deployed, only a portion of them can be used, or additional devices can supplement or replace those described above.

The input/output devices **105** could transfer information to the intention determination system **110** using the communication media **120**. The communication media could be a wireless digital network, an Ethernet, an optical network, a radio

network, or some other suitable communication media. As would be appreciated by one skilled in the art, the type of communication media may vary depending on the type of input/output device. A suitable communication media is described in detail in U.S. Provisional Patent Application Serial No. 60/223,813 filed on August 8, 2000, which is 5 hereby incorporated by reference in its entirety.

The intention determination system **110** receives information, such as instructions or orders, across the communication media **120**. This system pre-validates that orders conform to the issuer's intent and predicts conflicts based on analysis of current military doctrine, terrain, the orders of other units, weather, enemy placements, and other factors 10 that can be modeled in a rules-based environment. As previously mentioned, a similar application can be made for a medical implementation or management implementation of this intention determination system **110**.

The intention determination system **110** may include an input processor **142**, language converter **144**, database management system **146**, and analyzer **148**. Each of 15 these components, including the user interface **115**, can function as independent applications and can execute on distinct computers, as a multi-tiered architecture, or on a single machine. Consequently, additional modules can be developed as self-contained components. The modular nature of this intention determination system allows selective 20 choosing of the system configuration. For example, running the intention determination system **110** at a battalion level may warrant use on a single computer, while running this same system at a division level may warrant using multiple servers. Of course, additional modules and/or variations of the above modules can be included in the system.

The input processor **142** receives information such as text messages (orders, field 25 status reports, and so forth) and sensor data from the input/output devices **105**. As more clearly seen in **FIG. 2**, the input processor **142** includes an input interface **205**, preprocessor **210**, OPLAN processor **220**, OPORD processor **225**, FRAGO processor **230**, and SITREP processor **235**. This input processor accepts and processes communications to determine their relevance. Subsequently, the input processor passes 20 these communications to the language converter **144**.

The input interface **205** passes the received communication to the preprocessor **210**. This preprocessor parses communications to determine the type of report that was entered by using data types inherent to the selected programming language. Through initial parsing, the preprocessor **210** can determine which connected processor should 5 receive the communication. For example, the preprocessor **210** could indicate that a situational report was received and should be transferred to the SITREP processor **235**. Similarly, this preprocessor transfers an operational plan (OPLAN) to the OPLAN processor, an operation order (OPORD) to the OPORD processor **225**, and a fragmentary order to the FRAGO processor **230**.

10 The function of the processors within the input processor **142** varies depending on the type of implementation. For the military implementation shown in **FIG. 2**, the OPLAN Processor **220** confirms that the OPLAN is approved and passes it to the OPORD Processor **225**. For example, the OPLAN processor **220** may receive from the preprocessor **220** communication that says “24<sup>th</sup> Infantry Division (mechanized) conducts 15 corps main attack in zone to block Euphrates River Valley; continues attack to east to destroy enemy forces.” When this OPLAN is approved, the OPLAN processor **220** passes this OPLAN to the OPORD processor **225**.

20 The OPORD Processor **225** then cycles through the OPORD pulling out fragmentary orders, or FRAGO sentences, at each cycle. For example the FRAGO sentences could be “Report to base camp to replenish ammo,” “Patrol NW of base camp 25 (OBJ CORN), or some other suitable fragmentary order. The OPORD processor **225** passes each FRAGO to the FRAGO processor **230** along with information that includes the paragraph of the OPORD and unit information. The FRAGO processor identifies the relationship between the FRAGO and OPORD. For example, the FRAGO processor **230** could identify that this FRAGO should be the first FRAGO that gets executed to accomplish the OPORD.

30 Like the FRAGO processor **230**, the SITREP processor **235** processes information, such as sensor data, instructions, or other messages, that provides situational reports. For example, one of the sensors **132** could transmit a report (in the form of a text message, activation signal, or other report) regarding enemy movement.

After the preprocessor **210** receives this report, this preprocessor passes the report to the SITREP processor **235**, which identifies the type of situational report. As can be appreciated by one skilled in the art, the processors **220 - 225** can vary if the input processor **142** is used in another implementation, such as a medical or management

5 implementation.

When the data emerges from the FRAGO processor **230** or the SITREP processor **235**, it enters the language converter (LC) interface **240**. The LC interface **240** transfers information between the language converter **144** and a data controller **245**. The data controller **245** stores, using the data objects **247**, information relevant to the operation of the input processor **142**. In addition, the data controller notifies the database **146** and the analyzer **148** of changes that were made by the input processor **142**.

In addition to the input processor, the intention determination system **144** also includes the language converter **144**. The language converter **144** converts the English (or other language) text received from the input processor **142** to symbolic representations of ideas that may contain spatial or temporal concepts. These symbolic representations may be referred to as restructured messages, or spatial-temporal strings.

**FIG. 3** illustrates the processing of a fragmentary order as it goes through the language converter **144**. The fragmentary order that leaves the input processor **142** reads “Attack to BP103 at 0800 and establish AO FOX.” The language converter **144** separates this message into two the sequential actions “Attack to BP103 at 0800” and “Establish AO FOX.” Converting “Attack to BP103 at 0800” to spatial temporal format produces “At [1/6/1999 0800 Future [é, attack (BP [BP103])]].” The é operator indicates that an event, which is an attack, follows. The attack is on BP 103, represented by the spatial operator BP and will take place in the future at 1/6/1999 at 0800. One skilled in the art will appreciate that the language converter **144** includes a defined vocabulary, such as verbs, adverbs, and adjectives that enables conversion of natural language statements to a spatial-temporal format.

Similarly, converting “Establish AO FOX” to spatial temporal format produces “create (AO[AO FOX])”. This indicates that an area of operations (AO) will be created that is named AO FOX. Combining the statements produces “At [Start [é, At [1/6/1999

0800 Future [é, attack (BP [BP103])]] create (AO [AO FOX]).” The structure of this statement enables efficient reading to mean that an attack will take place on 1/6/1999 at 0800 on battle position BP 103, which will create the area of operations AO FOX. Hence the natural languages message “Attack to BP103 at 0800” was converted into easily 5 processed machine language that aides in effective processing of the statement.

In an alternative embodiment for parallel processing of decomposed statements, the language converter **144** can include a pre-processor and a post-processor. The pre-processor will send each successive paragraph to independent machines/CPUs and the post-processor will recombine these sequential strings afterwards. Performance testing can determine if the language converter **144** should function linearly or in parallel. 10

Once the instructions or other data are converted to a restructured message by the language converter **144**, the language converter **144** sends the message back to the data controller **245** in the input processor **142**. The data controller **245** forwards the restructured message to the database **146** and updates the analyzer **148** accordingly. 15 Before forwarding the restructured message, the language converter **144** can assess if the received message was a query, an order, or a report or other message. For example, a user could ask “When is BSD24 attacking BP103?” The language converter would interpret this statement as a question instead of report information that should be stored in the database.

20 Turning now to **FIG. 4**, there is illustrated a functional block diagram of the database management system **146** of **FIG. 1** showing sample tables, or data storage locations, within the database system. The database system **146** is a standard database with spatial and temporal engine enhancements. This module may be composed of several databases including, but not limited to, a unit capabilities database, an OPORD 25 database that also tracks FRAGOs, a SITREP database, a terrain database, an equipment database, and a military doctrine database. Alternatively, medical databases could be included in a medical implementation of the system **100** and inventory, schedule, or vehicle location databases could be included in a management implementation.

The database management system **146** stores all spatial and temporal information relevant to the intention determination system **110**. Some sample tables include a FRAGO table **405**, soldier table **410**, weapons attribute table **415**, platoon table **420**, and mission table **425**. The FRAGO table **405**, for example, could store all of the fragmentary 5 orders received for a given OPLAN. In contrast, the weapons attribute table **415** could list the attributes of all of the weapons assigned to soldiers in a given division, for example. Other tables could include an ammunition table, weather condition table, and dependency tables that indicate contact individuals. As mentioned above, “table” as used herein means any data storage location (whether tabular or not).

Because the database management system **146** includes temporal 10 enhancements, it time-stamps and keeps a permanent record of received data, which enables retrieval of data regardless of when it was stored. Moreover, the temporal nature of the database management system **146** supports recognition of time periods apart from discrete points in time. This database management system is also self-indexing and self- 15 assembling, which enables maintenance of the data in an organized manner with minimal human effort.

Turning now to **FIG. 5**, there is illustrated a functional block diagram of the analyzer **148**. The **148** identifies conflicts and subtle interdependencies by processing the restructured messages that emerge from the language converter **144**. The analyzer 20 **148** uses a modular rule-based analysis system in testing the restructured messages and associated information. This analyzer **148** assesses current and future situations for conflicting orders. A military example of a conflicting order could be the issuance of a command to send a unit over impassable terrain. The analyzer **148** could flag this order as problematic in advance by comparing the unit’s planned route with known geographic 25 data. Data feeds from satellite will likewise enable suggestions of the safest route. Hence, the analyzer **148** provides predictive conflict assessment for both present and future situations. In addition, the analyzer **148** completes validity checks on the data it receives. For example, the analyzer **148** will check an area table within the database 30 management system **148** to confirm that an area specified in a received fragmentary order actually exists.

Generally, the analyzer 148 includes an input interface 505 that receives natural language messages and spatial temporal messages, as well as associated information such as weather conditions from the database management system 146. Generally, the input interface 505 processes the information received from the database and identifies, 5 based on the data type, whether it should be sent to a data controller 510 or a logic system 515. Typically the data controller 510 receives information not previously processed. Hence, it initializes this data and sets up appropriate relationships. Moreover, the data controller 510 holds and tracks all the information relevant to the analyzer 148. This data is stored in a set of data objects, not shown, that are controlled 10 and manipulated by the data controller. When the data controller 510 receives new data objects, it notifies the database interface 520 and the logic system 515 of the new information.

The logic system 515 uses a set of predefined rules, such as military doctrine, to determine if the attributes of any of these data messages violate any rules. For example 15 when an instruction is received to initiate an attack, the logic system determines whether the commander has followed the proper military procedures based on the predefined rules. The database interface 520 communicates with and constantly scans the database management system 146 for new information from other systems and passes this new information in the form of objects to the data controller 510. The analyzer 148 20 also includes an output interface 525 programmed to transfer information between the intention determination system 110 and the user interface 115. For example, the output interface 525 could transfer an alert to the user interface 115 that predicts a conflict.

In addition to the intention determination system 110, the automated system 100 includes the user interface 115. FIG. 6A is a Windows-based screen 600 generated by 25 the user interface 115 illustrating the condition of the battlefield using a multi-panel format. Within the screen 600, multiple panels present a description of the current battlefield situation and communicate any changes or conflicts received from the analyzer 148. For any one of these panels, using a color scheme such as red (alert), green (safe), yellow (caution), blue (reference information), and black (environment) can highlight the 30 relative importance or function of the displayed information. Scroll bars 601 enable

viewing additional portions of a panel. As would be appreciated by one skilled in the art, the content of the multi-panel varies as the implementation varies. For example, using the user interface **115** in a medical implementation could result in the display a patient's vital signs in one of the panels.

5 The screen **600** includes a display panel **605** that graphically presents the units, areas, terrain, and relationships. By placing objects on a terrain map, real-world locations can be easily identified. For example, the display panel can include representative icons. In addition, using color can enable quick observation of some unit types, area types, or relationship types. For example, caution areas could be red and friendly to enemy relationships could be red lines. The display panel **605** could also include overlays that identify time, temperature, wind, or visibility. In addition, specifics regarding the terrain can also be indicated with the use of overlays. To display conflicts in the display panel **605** for a unit, the user interface **115** may cause the representative icon to begin flashing.

10 15 The screen **600** also includes an inspector panel **610** that provides specific information on objects that appear in the display panel **605** and the message panel **615**. The inspector panel **610** may be composed of a pop-up menu **611** and a display area **612**. The pop-up menu **611** is used to select a topic area that the user wishes to get the details of for a selected object. Typically, objects will include a general pop-up menu that 20 displays general information about the object. However, portions of the contents of the pop-up menu **611** are dynamic and determined by the object, area, or message selected. For example, only units that can transport cargo will include a "cargo" pop-up menu.

25 In addition to the inspector panel **610**, the screen **600** includes a dynamic message panel **615**. This message panel displays fragmentary orders and situational reports as processed by the intention determination system **110**. As the analyzer **148** assesses validity and conflict issues regarding the messages received, the message panel **615** displays these messages. In one embodiment, new items are added to the bottom of the list enabling a user to scroll through all the received messages.

30 Including a preferences panel **620** in the screen **600** enables the user to set display preferences for objects that appear in the display panel **605** and the message

panel **615**. The preferences panel **620** uses a spherical node-based navigation system particularly suitable for dynamic applications. A portion of the preferences panel **620** includes four navigational nodes representing preferences, areas of operation, units, and fragmentary orders. Selection of one of these nodes positions that node in the center as described later with reference to **FIG. 6C**. Of course, the node-based navigation system can be provided with another number of nodes and/or with the nodes representing other things such as medication type, medication dosage, pre-existing conditions, and patient history in medical applications, and inventory, production scheduling, employee availability, and vehicle location in a management system applications.

In addition to navigational nodes, the preferences panel **620** includes navigational buttons **622** for quickly jumping between areas. The branch mode and spherical mode navigation button allows switching between spherical navigation and linear navigation. Other buttons could include an areas (A) button that allow quick navigation to the areas node of the preferences tree. Similarly, a relationship button (R), fragmentary order button (F), and units button (U) enable efficient navigation to their respective portions of the preferences tree. The preferences panel **620** also includes navigational clues that provide a quick-reference for users. For example, the preferences panel **620** lists the immediate parent of the current node next to the label Parent and lists the main branch of the preferences under display.

Turning now to **FIG. 6B**, it depicts two Windows®-based screens generated by the user interface **115** illustrating the condition of the battlefield for a simulated mission at subsequent time intervals. Within the display panel **605** of the screen **630**, object **606** moves toward destination **607**. To better assess why the object **606** is moving toward the destination, a user can review previously issued orders in the message panel **615**. One fragmentary order (FRAGO) indicates that unit TJ345Y should report to the base camp to replenish the ammunition supply. Subsequently, screen **640** indicates that the object **606** has reached the destination **607**. Selecting the object produces additional specifics in the inspector panel **610**. Consequently, a user can identify that object **606** is a tank with three subunits under the command of Lieutenant E. Rommel.

**FIG. 6C** depicts two Windows-based screens generated by the user interface **115** illustrating the node based navigational nature of the user interface for a simulated mission. The screen **650** includes a preferences panel **655** with navigational nodes labeled “Areas,” “Units,” “FRAGOs,” and “Relationships.” In screen **660**, the preferences panel **665** differs from the panel **655** because a user selected the units navigational node. Consequently, a user can select from any one of the new navigational nodes “Status Bars,” “# Subunits,” “Commander(s),” “Unit(s),” and “State Message.” In addition, selecting the units node twice returns the user to the portion of the preference tree displayed in preferences panel **655**. Using spherical navigational nodes, users can efficiently navigate to a desired area without becoming disconnected from a previous area.

Finally, the screen **600** includes a zoom display panel **625**. This panel enables omni-directional pan and zoom. With this tool, users can focus on their geographical area of interest on the background map.

**FIG. 7** is a logic flow diagram illustrating the operation of the automated conflict notification and prediction routine **100**. In step **705**, the automated conflict notification and prediction routine **700** receives stored orders and associated data. As previously mentioned, the routine **700** and receive the data using any one of several types of communication media, including a broadband wireless digital network. Step **705** is followed by step **710**, in which the automated conflict notification and prediction routine **700** determines if the received data was a query, such as “What is over this hill?”. Otherwise, the “YES” branch is followed to the routine **745**. If the data was not a query (e.g., a situational report of enemy troop location or an attack order), the “NO” branch is followed from step **710** to step **720**. In step **720**, the conflict notification and prediction routine **700** the type of data it received. In a military implementation, the data could be an operation plan for situational report, for example.

Step **720** is followed by step **725**, in which the automated conflict notification and prediction routine **700** determines if the data should be parsed. In making this decision, the routine **700** could consider the type of data received. For example, receiving an operational order warrants parsing while receiving a situational order does not. If the

conflict notification and prediction routine **700** parses the data, the “NO” branch is followed from step **725** to step **730**. Otherwise, the “YES” branch is followed from step **725** to step **735**, in which the data is parsed.

Step **735** and the “NO” branch from step **725** are followed by step **730**, in which 5 the data is sent to a processor. Step **730** is followed by step **740**, in which the data is converted into a spatial temporal format, or restructured message. These restructured messages can be more effectively processed by the conflict notification and prediction routine **700**.

In step **743**, the routine **700** receives data from any one of the input devices 10 **105**. Step **740** and step **743** are followed by routine **745**, in which both the restructured data and original data are analyzed. Routine **745** is followed by step **750**, in which the user is notified. The conflict notification and prediction routine **700** may notify users of potential conflicts. Step **750** is followed by step **760**, in which the automated conflict 15 notification and prediction routine **700** determines if the response has been received from the user. If the response has not been received, the “NO” branch is followed from step **760** to “END”. Otherwise, the “YES” branch is followed from step **760** to step **705** where the conflict notification and prediction routine **700** receives data. Because the conflict notification and prediction routine **700** controls an evolving or self-learning system **100**, the routine **700** is recursive. Hence, the “END” step is followed by the “BEGIN” step, in 20 which the routine **700** repeats in an ongoing manner. Moreover, the distributive nature of the system **100** enables parallel execution of routine **700** by different portions of the system.

**FIG. 8** is a logic flow diagram illustrating the analyze data routine **745**. **FIG. 8** continues from step **740** in **FIG. 7**. In step **810**, the analyze data routine **745** determines 25 if the received data was a query. If the data was a query, the “YES” branch is followed from **810** to step **815**, in which the query is processed. Step **815** is followed by the CONTINUE step **750**, in which the analyze data routine **745** returns to step **750**.

If the data should not be queried, the “NO” branch is followed from step **810** to step **820**, in which units/areas within the received message are identified. Step **820** is 30 followed by step **825**, in which the existence of units/areas is determined. For example,

the analyze data routine **745** determines if the identified area actually exists. Step **825** is followed by step **830**, in which the analyze data routine **745** determines if the data should be flagged. If the data should not be flagged, the “NO” branch is followed from step **830** to step **835**, in which the data is stored.

5 Step **835** is followed by step **840**, in which the analyze data routine **745** determines if all units/areas in the received messages has been identified. If the units have been identified, “YES” branch is followed from step **840** to routine **845**, in which the data conflicts are analyzed. If the data should have been flagged, the “NO” branch is followed from step **830** to step **850**, in which the data is flagged. In step **855**, the analyze data routine **745** stores the flag data in data objects, for example. Routine **845** and step **855** are followed by the CONTINUE step **860** which returns to step **750** on FIG. 7.

FIG. 9 is a logic flow diagram illustrating the analyze data conflicts routine **845**. In step **905**, the analyze data conflict routine **845** retrieves stored orders, such as operational orders, fragmentary orders, and associated data. Step **905** is followed by step **910**, in which the orders are analyzed using rule-based methods. Step **910** is followed by step **915**, in which additional information associated with the orders is retrieved. For example, weather information or vehicular information could be retrieved because they could affect the execution of the orders.

Step **915** is followed by step **925**, in which analyze data conflict routine **845** determines a conflict exists. If a conflict does exist, the “YES” branch is followed from step **925** to the “CONTINUE” step **930**, which returns to step **850** shown on FIG. 8. If a conflict does not exist, the “NO” branch is followed from step **925** to step **935** order is indicated as valid. Step **935** is followed by the “CONTINUE” **940**, which returns to step **750**.

25 While the present invention has been described above mostly as embodied in an intention-based automated conflict prediction and notification system for military operations, it will be understood that the invention can be alternatively embodied in systems for use in other fields. Such fields include business and personal management, medical treatment, and other areas that include nondeterministic situations with dynamic 30 elements and for which potential conflict identification and resolution would be

advantageous. For example, in management applications, the system can be used for scheduling work groups such as salespersons or work crews, for coordinating the position and movement of satellites, commercial carriers (such as aircraft, trucks, and trains), and/or other objects, for planning and scheduling construction, engineering,

5 manufacturing, or similar projects, for inventory control applications for any type of product, or for personal day planner applications. In medical treatment applications, the system can be used for avoiding prescribing medications that should not be taken together, avoiding medical procedures such as certain surgeries, diagnostic procedures, treatment procedures, and so forth that should not be performed on persons taking 10 conflicting medications or with certain conditions, or in other medical applications where conflicts may arise.

It will be understood that the method described above can be carried out in various sequences, and the sequences describe herein are provided as an illustration only and by no means as a limitation. It will be further understood that the terms "a," "an," and 15 "one" as used herein are not intended to mean only "one," but may also mean a plurality, and terms used in the plural form can include the plural form.

In view of the foregoing, it will be appreciated that present invention in an exemplary form provides an automated intention-based predictive support system. It should be understood that the foregoing relates only to the exemplary embodiments of 20 the present invention, and that numerous changes may be made therein without departing from the spirit and scope of the invention as defined by the following claims.